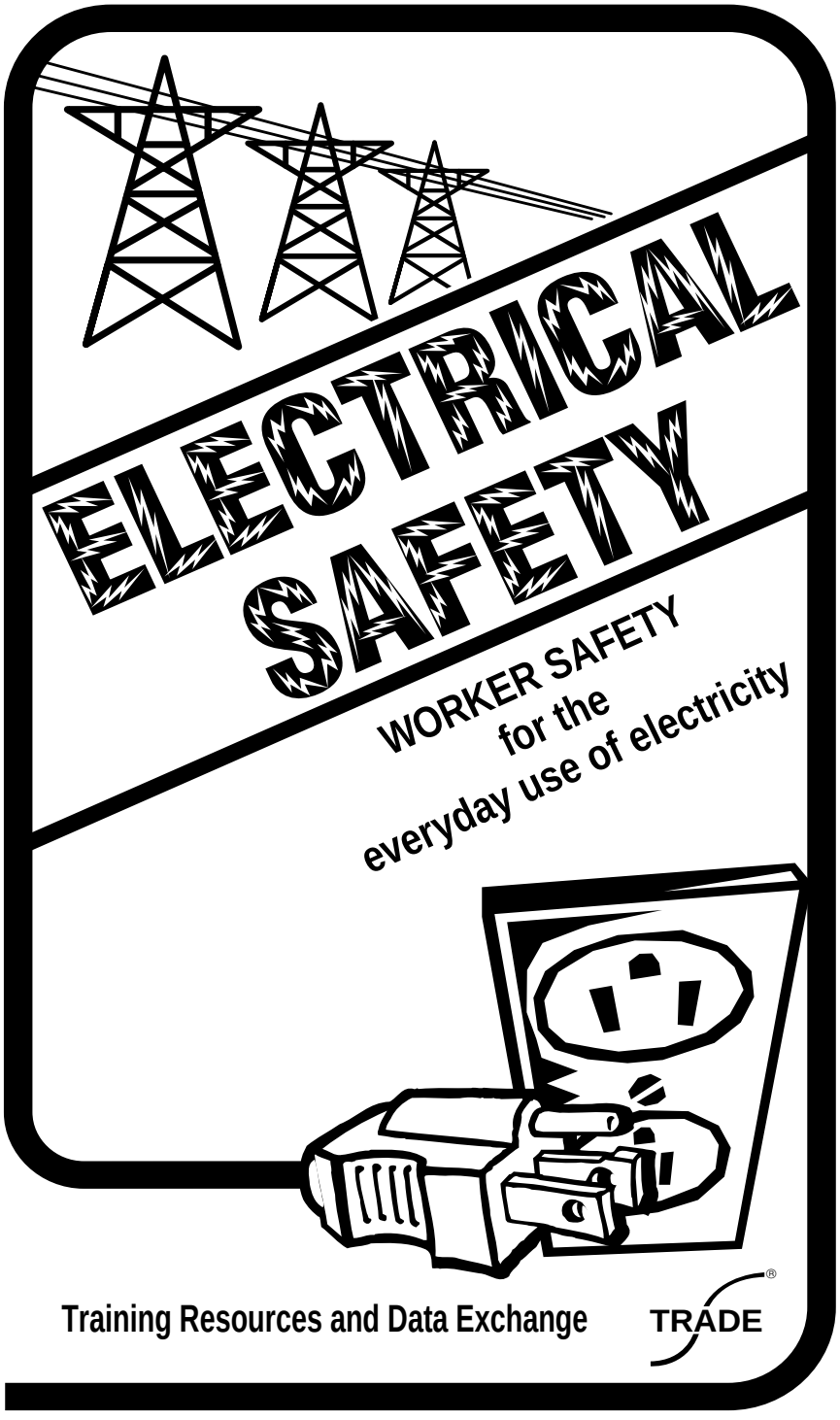
INSTRUCTOR'S GUIDE

WITH STUDENT HANDOUT



PRODUCED AND DEVELOPED BY

LOS ALAMOS NATIONAL LABORATORY

INSTRUCTOR'S GUIDE
WITH STUDENT HANDOUT

Produced and developed by the
Industrial Hygiene and Safety Group / ESH-5
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Contents

Electrical Safety

Total Running Time: 17 minutes; Color; VHS

1. Overview

Electrical Safety presents an introduction for the general population to the safe use of electrical power in the workplace. Electrical power is first traced from power plant transmission lines all the way to the electrical outlets that feed building maintenance equipment, large machinery, research equipment, and office equipment. The video introduces the concepts of electrical pathways, voltage, and current, and applies these concepts to electrical hazards and the need for safe work practices whenever one is working around electrically powered equipment. The video then identifies government and private agencies which help to establish electrical regulations and guidelines, particularly as they relate to Department of Energy (DOE) facilities. A variety of safe work practices are demonstrated so that each individual can interact safely with his/her own work environment. These safe practices include using properly grounded equipment, recognizing locked-out equipment, replacing frayed cords, preventing overloaded circuits, responding to liquid spills near electrical equipment, and responding properly after an electrical shock. The video concludes by discussing the dangers of lightning and the proper indoor and outdoor responses to a lightning storm.

2. Background

Target Audience—*Electrical Safety* is designed for all workers within the general population of DOE. “General population” refers to workers who face normal electrical risks as part of their workday. Ages range from 18 to 65, and educational backgrounds range form high-school diploma to post-doctorate degree. Also, some viewers may experience English as a second language. Elementary concepts and language are therefore defined for select viewers without compromising overall interest for the general audience.

Development—*Electrical Safety* was developed to assist workers within the general population at DOE facilities. It meets training requirements for the general worker as specified in Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910 - Subpart S, and DOE Electrical Safety Guidelines. (However, this video does not meet training requirements for electrical workers.)

3. Uses for this video

Electrical Safety may be used as

- ✔ An integrated component of General Employee Training (GET)
- ✔ Refresher training for large or small groups
- ✔ Training for temporary workers, such as office workers, technicians, or visitors, who are not trained electrical workers but who may move through areas with high-voltage equipment

4. Before showing this video

Before showing *Electrical Safety*, you should finish reading the Instructor's Guide, preview the video, and identify any information that may differ from specific practices at your facility.

You may want to provide handouts for your viewers. An *Electrical Safety* student handout is provided as an attachment with this guide for easy photocopying.

You may also want to provide your viewers with emergency telephone numbers for your facility if they need to request electrical repairs and upgrades, report an electrical accident, or request medical assistance.

5. Showing this video

Because video monitors are relatively small, groups viewing *Electrical Safety* should be limited in size so that everyone can easily see and hear the video. If small groups are not feasible, two or more video monitors may be necessary.

6. Learning objectives

After viewers have watched *Electrical Safety*, they will be able to recognize

- ✔ Different electrical work environments at their facility
- ✔ The definitions of voltage and current
- ✔ Electrical hazards in the work place
  - their location
  - the dangers they pose in the work environment
  - ways to avoid them
- ✔ The importance of proper grounding of equipment
- ✔ Essential safe work practices in office environments
- ✔ The need to seek immediate medical attention if an electrical shock occurs
- ✔ What to do during a lightning storm

7. Discussion questions and review

Suggested Questions—After showing *Electrical Safety*, you may want to pose the following questions as a review:

- ✔ How can you avoid becoming part of an electrical loop?
- ✔ How hazardous are common wall outlets and electrical lamps?

- ✔ What kinds of risks are the general population exposed to?
- ✔ What is a “dead front”?
- ✔ When is it okay to use a plug that has the grounding prong cut off?
- ✔ Where would you use a ground-fault circuit interrupter?
- ✔ What do you do when you encounter locked-out equipment?
- ✔ Will a circuit breaker protect you from electrical hazards?
- ✔ What should you do if you receive an electrical shock?
- ✔ What should you do if you’re outdoors during a lightning storm?
- ✔ If you are on the telephone during a lightning storm, should you continue your conversation?

Case Study—The following case study is offered as an example of an actual electrical accident. You may wish to substitute or add to this case study with examples from your own facility.

On July 11, 1996, at Los Alamos National Laboratory, TA-53, Building MPF-14, a student employee was working alone and was taking electrical measurements on a high-voltage power supply within a microwave oven. The cover of the microwave had been removed to allow access to the high voltage terminals of the power supply. While conducting the measurements, the student improperly connected and inadvertently energized a high-voltage probe used to take the measurements. The student, who was working alone, then touched the energized probe and received a 4000-volt electrical shock.

Immediate responders performed initial first aid and contacted emergency response personnel. Emergency responders performed additional first aid and transported the student to Los Alamos Medical Center within 25 minutes of the shock. All electrical equipment in the immediate vicinity around the student’s work area was de-energized and proper notifications were made. The student had been rendered unconscious and suffered physical injuries. At the Medical Center, the student regained consciousness, was treated for his injuries, and was released seven days after the accident. He is expected to fully recover. (ORPS Report: ALO-LA-LANL-ACCCOMPLEX-1996-0010)

LESSONS LEARNED

- All specified hazardous work must comply with the “two-person rule,” which requires a qualified second person to be present at all times during hazardous work to correct work errors or summon assistance.
- All electrical equipment should be de-energized before work is begun on exposed circuits and terminals.
- Specific electrical safety procedures for a given operation must be clearly communicated by management. All employees involved in the operation must then demonstrate that these procedures are understood.

8. Follow-up activities

To support *Electrical Safety*, it is important that you and your students review

- ✔ Your facility's electrical safety program
- ✔ Your contact for reporting potential electrical hazards
- ✔ Your contact for medical assistance if an electrical accident occurs

9. Additional resources

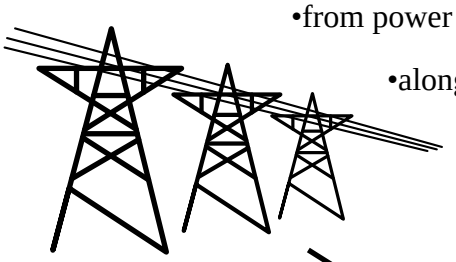
Electrical Safety Kit, National Electrical Safety Foundation (NESF). This kit includes electrical safety guidelines and checklists, as well as camera-ready brochures and artwork. You can obtain a kit by contacting

The National Electrical Safety Foundation
1300 N. 17th Street–Suite 1847
Rosslyn, VA 22209
Tel: (703) 841-3229
FAX: (703) 841-3329

Electrical Safety Student Handout

Electrical Power from There to Here

Electrical power travels



•from power plants

•along power transmission lines

•to your facility substation

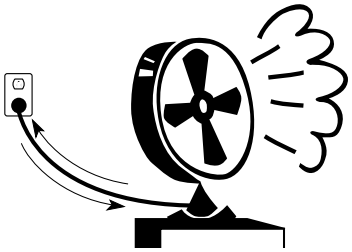
•to switchgear

•along your facility transmission lines

•to your building substation

•through circuit breakers

•to your work area

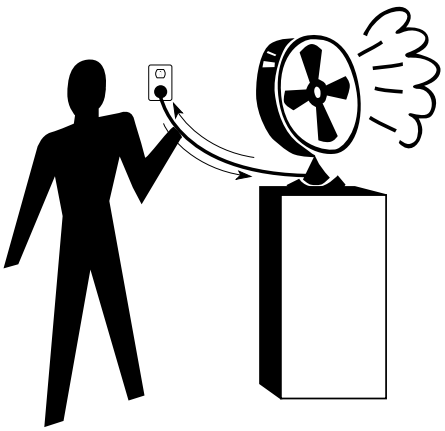


The Loop

For electricity to work, it has to flow in a loop between its source and the equipment that is to be powered.

Avoiding the Loop

If someone or something becomes part of that loop, an electrical hazard occurs.



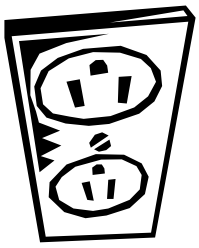
If you become part of the loop, the electricity may flow directly through your body, causing injury or even death.

Electrical hazards can result in

- electrical shock
- arc burns
- explosions

Electrical Hazards—Where They Come From

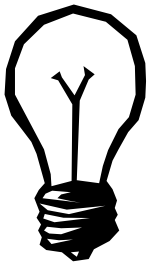
VOLTAGE
"electrical pressure"
(volts)



HAZARDS
50 volts or greater are hazardous.

A standard wall outlet is 120 volts, more than **twice** the hazardous level.

CURRENT
"flow of electricity"
(amps)



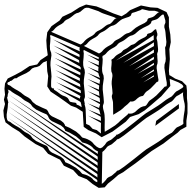
HAZARDS
A current of 1/10 amp may cause death.

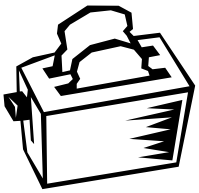
A 100-watt light bulb draws a current of 1 amp, which is 10 times this hazardous level.

Electrical Hazards—Where You Work

The kinds of hazards you are exposed to depend upon

- the type of work that you do
- the type of equipment that you operate





The **general population** uses electricity as part of their every day activities, both at home and at work, and are only exposed to normal risks.

Work is limited to

- office equipment and similar electronic equipment
- all appliances in the small kitchen areas

Low risk is found with all office equipment because it has a **dead front.**
All circuits are totally enclosed. There are no exposed circuits.

Possible electrical hazards with office equipment are the same hazards as at home.

You must still protect yourself because the hazards are real and encountered every day.

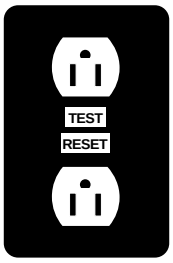
Regulations and Guidelines to Protect You

- **Occupational Safety and Health Administration**
  Guidelines for training, work practices, equipment, and personal protection
    - **National Electrical Code**
      Requirements for all facilities, buildings, and installations
        - **DOE Electrical Safety Guidelines**
          Guidelines for all DOE facilities
            - **Your Facility**
              Electrical safety program

Electrical Safety Practices

Maintain grounding of all outlets and plugs.
Never cut off the rounded prong or use adapters.

GFCI protected outlet



Use ground-fault circuit interrupters (GFCIs).

GFCIs protect you if you're in physical contact with conductive materials such as liquids, metals, concrete, or earth.

GFCIs are required in kitchens, bathrooms, and concrete areas.

Only use equipment that is approved by an appropriate agency.

Honor all safety signs.

Be cautious in areas with large machinery and research equipment.
Avoid these areas unless escorted or trained.

Stay away from locked-out equipment.

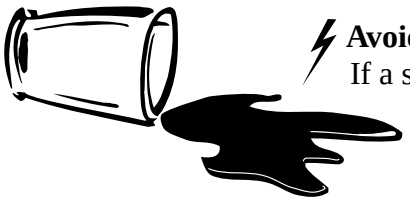
Electrical Safety Practices (cont.)

Replace frayed cords and broken equipment.

Keep electrical panels accessible for emergencies.

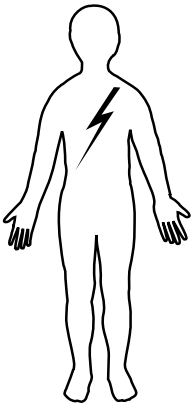
Do not overload circuits.

Do not overload extension cords.



Avoid liquid spills around office equipment.
If a spill occurs, turn off or unplug the equipment.

Seek immediate medical assistance for all electrical injuries.

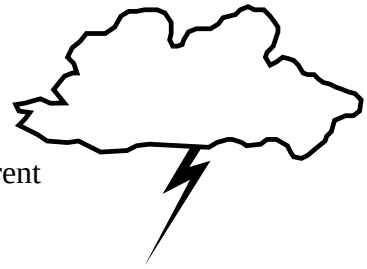


Electrical shock is the passage of electrical current through the conductive portions of the body (blood, nerves, and muscle tissue). The effects may not appear until well after the accident. Electrical shock is the more elusive and possibly more dangerous injury.

If an electrical shock does occur

- seek immediate medial attention
- report the shock, burn, or explosion to your supervisor or safety staff

Lightning Safety



Lightning is the flow of an electrical current from storm clouds to the earth.

If you're outdoors

- get into a building or a car with a metal roof
- if not, stay as low as possible, squatting down forming a ball with your body
- stay clear of trees, metal fences, or plumbing

If you're indoors

- stay away from sinks and showers
- avoid electrical equipment, including the telephone